

## LOW CLEARANCE HYDRAULIC WRENCH OPERATING MANUAL

### Instructions Before Use

1. Read and understand all instructions before operating the hydraulic wrench. Most malfunctions in new equipment are the result of improper operation and/or setup. It is the operators responsibility to read, understand, and follow all safety instructions.
2. Remove the hydraulic wrench from the shipping container and visually inspect all components for any shipping damage. If any damage is found, notify the carrier immediately. DO NOT USE TOOL.
3. Locate a solid, secure reaction point to absorb and counteract the forces created as the hydraulic wrench is operated.
4. Make sure the hydraulic hoses are free of the reaction point.
5. Momentarily pressurize the system. If the wrench tends to "ride up" or "creep", stop and readjust the reaction arm to a more solid and secure reaction point.
6. Cycle the hydraulic cylinder inside the wrench to ensure proper function.

Note: Each time the hydraulic cylinder inside the wrench is extended and retracted, it is called a cycle.

### Working Pressure

The maximum working pressure for this hydraulic wrench is 10,000 psi (68,900 kPa). Make sure all hydraulic equipment used with this wrench are rated for 10,000 psi (68,900 kPa) operating pressure.

### Hydraulic Connections

- Never connect or disconnect any hydraulic hoses or fittings without first unloading the wrench and the pump.
- Open all hydraulic controls several times to make



**WARNING** sure the system has been completely depressurized.

- If the system includes a gauge, double check the gauge to make sure pressure has been released.
- When making connections with quick disconnect coupling, make sure the coupling are fully engaged. Threaded connections such as fittings, gauges, etc., must be securely tightened and leak-free.

### IMPORTANT

Loose or improperly threaded fittings can be potentially dangerous if pressurized, however, over-tightening can cause premature thread failure. Fittings should only be tightened until they are secure and leak-free.



This is the safety alert symbol.

It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death



## DANGER

Denotes an imminently hazardous situation which, if not avoided, will result in death or serious injury.



## WARNING

Denotes a potentially hazardous situation which, if not avoided, could result in death or serious injury.



## CAUTION

Denotes a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

## CAUTION

Caution used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

## IMPORTANT

Denotes an operating or service procedure or condition considered essential for expedient and efficient operation and service.



## WARNING



Read and understand this material before operating or servicing this equipment. Failure to understand how to safely operate this tool could result in an accident causing serious injury or death.

- Only qualified operators should install, operate, adjust, maintain, clean, repair, or transport this machinery.
- Inspect tool before use. Replace any worn or damaged parts. Failure to observe these warnings can result in severe injury or death.
- Keep work area clean and well lit.
- When not in use, wrenches and accessories should be properly stored to avoid deterioration.



## WARNING To help prevent personal injury,



- Always wear eye protection whenever operating hydraulic equipment.



- Always wear hearing protection as required.



- Operation, repair, or maintenance of hydraulic equipment should be performed by a qualified person who understands the proper function of hydraulic equipment per local directives and standards.



- To prevent personal injury, use common sense. Do not use any power equipment under the influence of any mood altering substances.

- Never place your hands or other body parts near a hydraulic fluid leak.

Never use your hands or other body parts to check for a possible leak.

High pressure fluid can be injected under your skin causing serious injury and/or infection.



- Electric motors may spark, causing an explosion when flammable materials are present. Do not operate in an explosive atmosphere or in the presence of conductive liquids. Use an air motor or hand pump instead.

- To prevent electrical shock, make sure the pump is properly grounded and the proper voltage is being used.



## WARNING To prevent personal injury, the remote control must only be used by the wrench operator.

- Do not use hydraulic hoses, pump power, or remote control cords as means of moving the equipment.

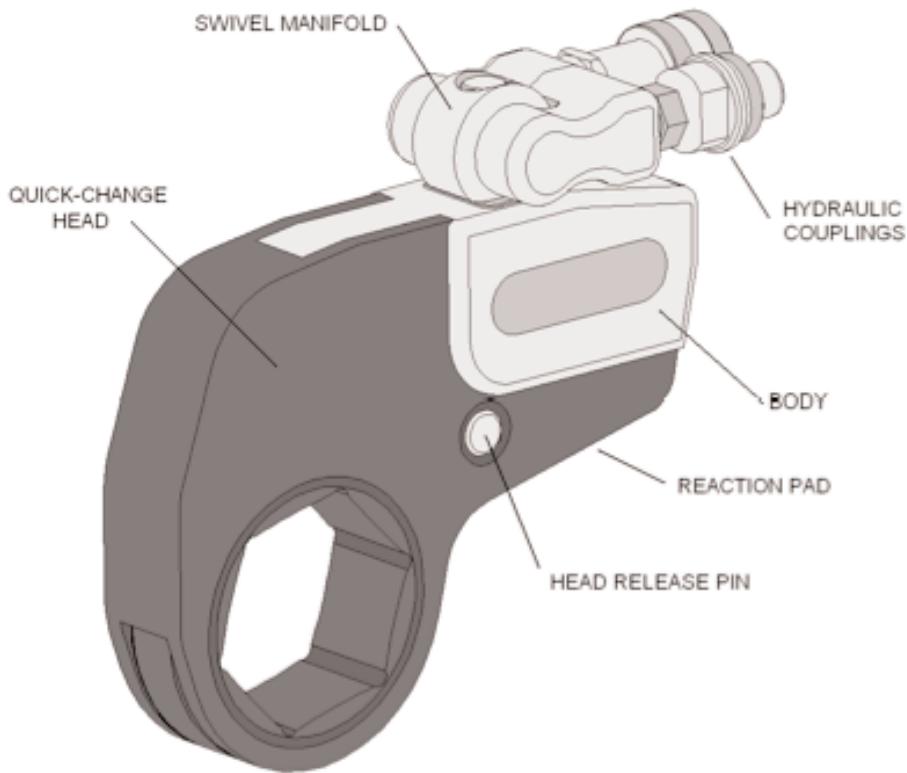
- Make sure all hydraulic connections are securely attached. Verify that the hydraulic hoses are not kinked.

- Remain clear of the reaction arm during operation. Never put body parts between the reaction arm and the reaction point.

- Always use top quality impact sockets in good condition and remain clear of sockets during operation because hidden flaws could cause breakage.

## CAUTION

To prevent wrench damage, always use the properly sized tool and accessories. Do not use a wrench for anything other than the intended purpose.



## OPERATION

**CAUTION** For top performance, frequently inspect wrench, pump, and accessories for visual damage  
Always follow instructions for proper wrench and pump maintenance.

Do not use other equipment to increase the capability (for example, hammering on socket wrench).

### General

Each hydraulic wrench is supplied completely assembled and ready for use. A hydraulic pump is required to provide the speed and pressure that makes the hydraulic wrench system efficient and accurate.

### Connecting the System

The hydraulic wrench head and power pack are connected by a 10,000 psi (68,900 kPa) single-line hose assembly. Each end of the hose will have one female connector.

NOTE: DO NOT switch the hose connector from female to male. It is necessary for the hose to have a female connector to engage the male connector on the hydraulic wrench.

### Electrical Connections

Make sure the power supply is compatible with the requirements of the electric pump motor. Minimize the length of extension cords and be sure they are of adequate gauge and grounded.

### Air Connections

Make sure the air flow rating is adequate and compatible prior to pressuring the pump. Make sure all connections are tight and leak-free

## Safety

- a) Never exceed the torque wrench maximum working pressure (Advance 689 Bar / 10,000 psi, Retract 69 Bar / 1000 psi)
- b) Keep hands and fingers clear of the torque wrench head and reaction pad area, before and during operation. Fingers could be inadvertently trapped if care is not taken.
- c) Keep other personnel clear of the working area and only allow trained personnel to use the equipment. Ideally rope off the working area.
- d) Prior to operation, ensure that all hoses, sockets and ancillary equipment is undamaged and fit for purpose. Ensure that all torque wrench components (i.e. head, body, etc.) are properly attached and secure. Ensure that the head release pin is properly located.
- e) Do not strike any of the components, including the socket, with a hammer in order to shock the nut free.
- f) Check that reaction structures are strong and rigid enough to accept the torque tool reaction forces. Do not use wedges, packing pieces, etc as a temporary reaction.
- g) Take care when handling equipment. Do not manoeuvre or carry the torque wrench by its couplings. Quick connect couplings are especially susceptible to knocks and damage and therefore care must be taken. Note that damaged couplings are difficult to connect. Do not force couplings.
- j) Do not retighten any equipment whilst under pressure. Do not move or rotate the swivel manifold whilst under pressure.
- l) Some torque wrenches weigh in excess of 20Kg, therefore ensure that lifting equipment is available and used.
- m) In some instances it may be necessary for the Operator to support the torque wrench whilst it is tightening, i.e. upside down applications. If the torque tool cannot be strapped into position using ropes, etc, then the operator must take the utmost care to avoid pinch points.
- n) Never use the torque wrench with just one hose connected to the Advance port (port 'A'). This will cause a pressure intensification within the retract chamber possibly leading to tool damage. Always ensure that both hoses are connected.

## Setting Torque

### Electric and Air Pumps

1. Make sure the system is fully connected and the proper power supply is available.
2. Use the Pressure/Torque conversion chart supplied with the wrench to find the required pressure setting. NOTE: On electric or air pumps, this pressure is set on the pump.
3. Turn on the pump.
4. Press and hold the remote control button.
5. Check the pressure on the gauge.
6. Increase or decrease pressure as required by loosening the locking ring on the pressure regulator valve and turning the thumb screw.

NOTE: Turn the thumb screw clockwise to increase pressure and counterclockwise to decrease pressure. When decreasing pressure, it is necessary to turn the thumb screw to a pressure setting below what is desired and gradually increase pressure to the desired level.

7. Once the desired pressure is stabilized, release the remote control button and tighten the locking ring.
8. Prior to tightening a nut, press the remote control button and confirm the correct pressure has been set.

### Manual Pumps

Find the required torque in the Pressure/Torque conversion chart and read across the chart to the corresponding pressure.

## Preparing the Torque Qrench for Use

### Assembling / Removing the Drive Head

Before the TWLC torque wrench can be used the correct drive head for the nut must be fitted to the TWLC body. Note that no special tools or spanners are needed to change the drive head. If a drive head is already assembled, it can be detached by pushing out the head retainer pin, and simply lifting out the body. The drive assembly will auto-disengage.

**NOTE : THE HEAD RETAINER PIN IS HELD CAPTIVE WITHIN THE HEAD SIDEPLATE, IT CANNOT BE COMPLETELY REMOVED**

To assemble a drive head, position the drive head onto the body, engaging the keyways on the inner surface of the drive head sideplates with the keys on the body. Slide the drive head fully onto the body and push the head retaining pin back into position. See Fig. 2 below.

Note that the body to head drive mechanism will auto engage during the drive head assembly process. If it does not, it will automatically attach during the first power stroke of the torque wrench.

NOTE: The torque wrench must be fully retracted before the head can be removed or attached.

**NOTE : HEAD RETAINING PIN DOES NOT  
DETACH FROM THE BODY. IT IS HELD  
CAPTIVE WITHIN THE SIDEPLATE.  
DO NOT PUNCH OUT !!**

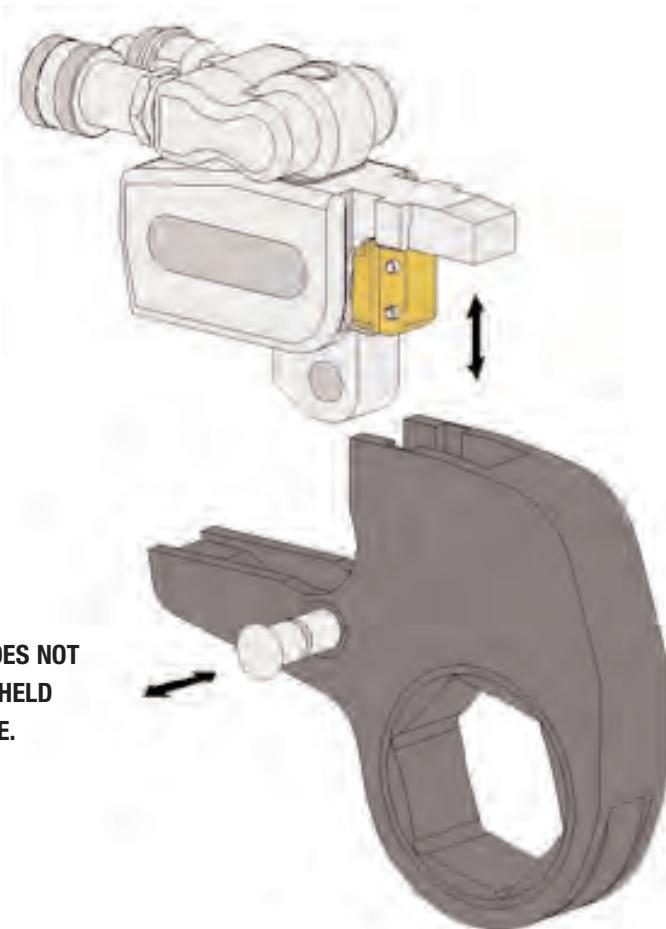
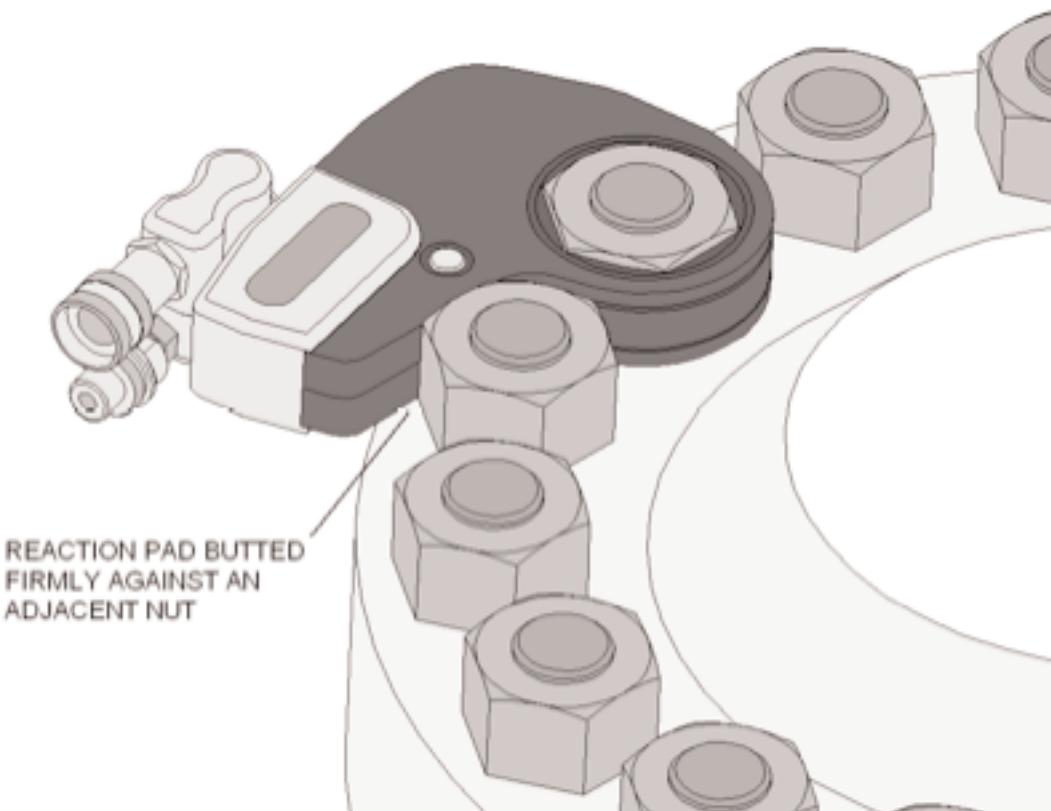


Fig 2. BODY AND DRIVE HEAD REMOVAL AND ATTACHMENT

## Positioning the Torque Tool onto the Nut

The TWLC torque wrench locates directly around the nut, with its built-in reaction pad designed to react against an adjacent nut. Fig. 3 below indicates correct positioning of the torque tool (shown in tightening mode). Always ensure that the reaction pad butts firmly against an adjacent nut or secure reaction structure.

### CORRECT POSITIONING OF TORQUE WRENCH



## Reaction Point Safety

Extreme care must be taken when selecting appropriate reaction points and the following must be borne in mind at all times.

- The reaction structure must be rigid enough to accommodate the reaction forces from the torque wrench, which can be extreme at times. Carefully assess the reaction points for suitability before applying the torque tool. If in doubt, contact the torque wrench supplier for advice.
- Ensure that the reaction structure is suitably shaped to accommodate the reaction pad. Tapered surfaces are generally unsuitable as the torque wrench tends to 'ride up' the taper, causing adverse tool loads. Flat surfaces are most preferred.
- If in any doubt over the suitability of the reaction point, contact your torque wrench Supplier as various reaction accessories are available which may prove more suitable.
- Don't improvise. Packing pieces, spacers, etc. are dangerous and must never be used as a makeshift reaction point.

## Operating the Torque Wrench

### Setting up prior to operation

Setting up the equipment only takes a few minutes and some simple checks during set up will aid in the success of the torquing operation.

- Obtain the torque value that is to be used for the tightening operation.
- Ensure that the bolt threads, nut threads and nut to flange contact faces are liberally coated with anti-seize lubricant of known friction co-efficient. Ensure that the lubricant friction co-efficient matches that which has been used to derive the torque value.
- Make sure that the torque wrench is suitable to deliver the required torque. Should the torque value exceed 80% of the torque wrench output, consider using a higher capacity torque wrench.
- Use the 'Pressure – Torque Conversion Chart' for the particular torque wrench to be used (supplied with the torque wrench) to obtain the required pump pressure.
- Make sure that the drive head to be used is of the correct type and size. A poor fitting or oversize drive head will damage nuts, induce inaccurate bolt loads and possible cause operator injury.

### Tightening Bolts

1. Connect the torque wrench to the pump unit. Ensure that the couplings are fully screwed together as they are self-sealing and will restrict oil flow if not fully connected.
2. Prior to applying the torque wrench to the application, the pump output pressure must be pre-set to relieve at the pressure obtained from the 'Pressure – Torque Conversion Chart'. This can be done with the torque wrench connected to the pump and resting on the floor or bench. Applying advance pressure to the torque wrench will extend the piston until it reaches the end of its stroke whereby the pump pressure will build. Holding the wrench at the end of its stroke will allow the pump pressure to be adjusted. Retract the torque wrench piston and advance again making sure that the pump relieves at the desired pressure setting.  
Blanking the pump outlets using blank couplings can also be done to carry out the pump pressure setting.

NOTE : Allow time for the wrench to retract. If another advance stroke is made before the torque wrench has fully retracted, the ratchet mechanism may not engage correctly, causing it to jump a ratchet tooth (probably damaging the ratchet). Before applying another advance stroke, make sure that the pump is idling at 69 Bar (1000psi), which indicates full retraction.

3. Apply the torque wrench to the nut to be tightened, ensuring that the reaction pad butts firmly and squarely against the selected reaction point.
4. Start the pump and advance the torque wrench. As the wrench strokes forward the reaction pad will press against the reaction point and the nut / socket will rotate. When the torque wrench reaches the end of its stroke, the pump pressure will build rapidly. Retract the torque wrench (the wrench ratchet mechanism will be heard clicking as it retracts), and apply another forward stroke
5. Several forward strokes are made until the nut ceases to rotate during the stroke, (known as stalling), but bear in mind that nut rotation will always cease at the end of the wrench stroke and must not be confused with the wrench stalling. When the wrench stalls, apply another forward stroke and observe the pump pressure gauge, which should read the desired pre-set pressure.
6. Retract the torque wrench, stop the pump unit, and remove from the nut.

## Loosening Bolts

1. Connect the torque wrench to the pump unit. Ensure that the couplings are fully screwed together as they are self-sealing and will restrict oil flow if not fully connected.
2. Prior to applying the torque wrench to the application, the pump output pressure must be pre-set to deliver the maximum pressure of 690 Bar (10,000psi). This can be done with the torque wrench connected to the pump and resting on the floor or bench. Applying advance pressure to the torque wrench will extend the piston until it reaches the end of its stroke whereby the pump pressure will build. Holding the wrench at the end of its stroke will allow the pump pressure to be adjusted. Retract the torque wrench piston and advance again making sure that the pump delivers full pressure.  
Blanking the pump outlets using blank couplings can also be done to carry out the pump pressure setting.
3. Apply the torque wrench and socket to the nut to be loosened, ensuring that the reaction pad butts firmly and squarely against the selected reaction point.
4. Start the pump and advance the torque wrench. As the wrench strokes forward the reaction arm will press against the reaction point. As the pump pressure builds (and thus torque applied to the nut), the nut will break free. Once the nut has been released, remove the nut by hand if loose enough, or alternatively use an impact wrench, it is not recommended to use the torque wrench.  
NOTE : Should maximum pump pressure be reached, and the nut has still not broken free, use a higher capacity torque tool (providing that the nut/bolt material will accept the higher torques without damage). Do not, under any circumstances, strike the torque wrench or nut / bolt in an attempt to 'shock' the nut free.
5. Retract the torque wrench, stop the pump unit, and remove from the nut.

## Notes on Loosening Bolts

Loosening of bolts using torque tools can be unpredictable and often unsuccessful, especially if the nuts and bolts are severely corroded. However, some measures can be carried out to increase the success rate of nut breakout.

- In general, loosening mildly rusted bolts requires up to twice the make up torque to release the nut. Heavily corroded bolts may take up to three times the make up torque. Ensure that the bolt and nut material is strong enough to accept these higher torques.
- Remove surface rust and scale using a wire brush. Apply releasing oil to the nut, bolt and bearing face, and allow time for the release oil to soak in and penetrate.
- Only use the torque wrench to break the nut free. Using the torque tool to wind the nut from the bolt can induce high torsion and reaction forces, therefore it is better to use an impact wrench to completely remove the nut.
- Never strike the torque wrench or nut / bolt in an attempt to 'shock' the nut free. This will cause damage to the torque wrench, and could result in operator injury. Evidence of torque wrench abuse will invalidate the Manufacturer's Warranty.

## Loosening

1. Set the pump to 10,000 psi (68,900 kPa).
2. Make sure the hydraulic wrench and the reaction arm are positioned for loosening.
3. Make sure the reaction arm is squarely against a solid reaction point.
4. Press and hold the remote control button.

NOTE: Pressure will build up as the socket begins to turn.

5. When an audible "click" is heard, the hydraulic cylinder inside the wrench is fully extended and will not turn the socket further.
6. Release the remote control button to allow the hydraulic cylinder inside the wrench to automatically retract until an audible "click" is heard. This completes one cycle.
7. Continue to loosen the nut with successive cycles until the nut can be removed by hand.

## Manual Pumps

1. To operate the hydraulic wrench with a hand pump, make sure the pump is rated at 10,000 psi (68,900 kPa) maximum pressure.
2. Connect the hand pump to the hydraulic wrench with a single-line hose assembly.

## Tightening

1. Determine the required pressure.
2. Make sure the hydraulic wrench and the reaction arm are in the tightening mode.
3. Pump the hand pump to advance the hydraulic cylinder inside the wrench until the socket stops turning.
4. Release the pump pressure. The hydraulic cylinder inside the wrench will automatically retract and an audible "click" will be heard. This completes one cycle.

## Manual Pumps (Tightening continued)

5. Continue to tighten the nut with successive cycles until the needle on the pump gets close to the required pressure.  
NOTE: The final torque check is made by paying close attention to the needle on the pressure gauge.
6. Pressurize the wrench until the needle stops on the required pressure.  
NOTE: When the pressure is released, the wrench will not make the audible "click".
7. Proceed to the next nut.

## Loosening

1. Make sure the hydraulic wrench and the reaction arm are on the loosening mode.
2. Pump the hand pump to advance the hydraulic cylinder inside the wrench. As pressure builds, the bolt will begin to loosen.
3. Stop pumping when the socket stops turning.
4. Release the pump pressure. The hydraulic cylinder inside the wrench will automatically retract and an audible "click" will be heard. This completes one cycle.
5. Continue to loosen the nut with successive cycles until the nut can be removed by hand.
6. Proceed to the next nut.
7. General Torquing Procedure

The following procedure is for use with SDT torque wrenches and outlines the basic steps in order to carry out the torque tightening of a flanged joint. It is important that personal protective clothing (gloves, footwear, safety helmet, eye protection) is worn at all times not only by the Operator, but also by any personnel within the work area. The torquing procedure is compiled around using a single torque wrench, the object of the procedure being to accurately achieve a pre-determined residual bolt stress.

## SAFETY: Prior to commencement of bolt torquing ensure that:

- All necessary safety precautions have been carried out
- Personnel involved in torquing are competent and fully trained in the use of hydraulic torque tools and tightening techniques.
- The procedure and data to be used is authorised by a responsible Engineer.
- The joints / pipework to be worked on are not 'live'. Joints must be at zero pressure and free from hazardous substances.
- Torque value selected must be based upon the lubricant applied.

STAGE 1 Number each bolt consecutively, 1, 2, 3 etc

STAGE 2 Using torque wrenches (if necessary), square up the flanged joint.

STAGE 3 Working in a diametrical sequence (tightening opposite bolts) apply the minimum torque available. i.e. set pump to lowest possible output (1000psi). Note the sequence used.

STAGE 4 Repeating the above noted tightening sequence, apply approximately 25% of the torque value specified in the torque data.

STAGE 5 Using the same noted tightening sequence, apply approximately 50% of the torque value specified in the torque data.

STAGE 6 Using the same noted tightening sequence, apply the full torque value specified in the torque data.

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STAGE 7 Working in a clockwise (or anti-clockwise) direction, make a final pass around the flange, tightening each bolt to the full torque value specified in the torque data.

STAGE 8 Following completion of Stage 7, using a hammer, "ring" each nut to ensure that each bolt has been correctly loaded and that no slack bolts remain.

## Maintenance and Servicing

### Post-Use Maintenance

In order to keep the TWLC torque wrench in good working condition, it is recommended that simple post-use maintenance be carried following each period of use.

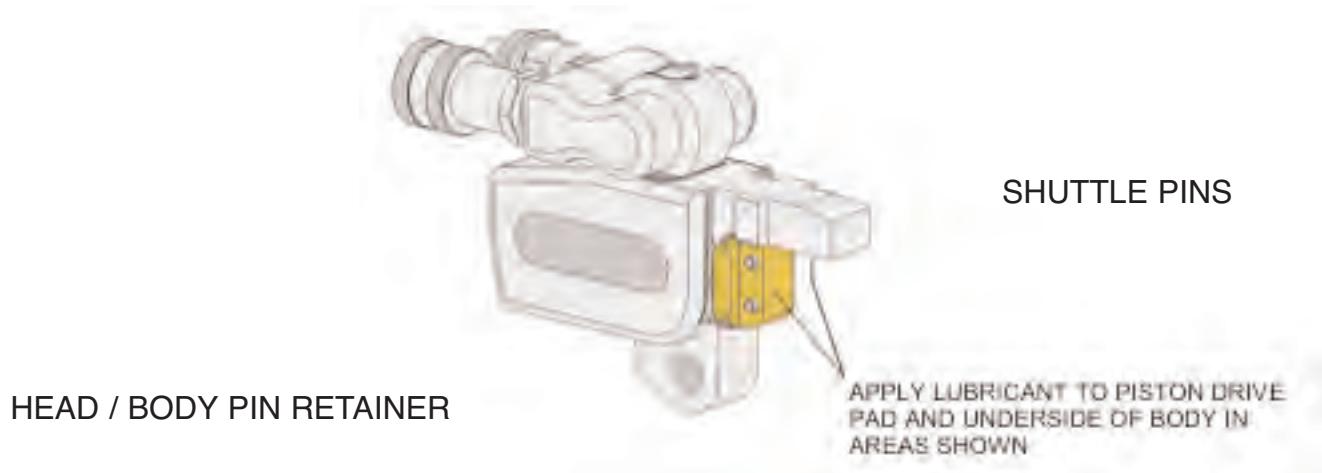
### TWLC Torque wrench

1. Wipe away any debris that may have accumulated, particularly around the swivel manifold and hydraulic couplings.
2. Remove the drive head from the body. Check the following areas (see diagram) :
  - Hydraulic Couplings for signs of damage – replace if evident.
  - Shuttle pins. Ensure they are present and spring freely.
  - Head / Body Pin retainer. Ensure it is undamaged and operates correctly.
  - Swivel Manifold. Ensure the spiral retaining ring is present and fitted correctly.

Re-lubricate the areas of the body as shown below using 'KSP Easyrun 100 MoS2 Anti-Scuffing Paste'. It is recommended that the drive head is re-assembled onto the body for storage to prevent ingress of dirt into the drive mechanism.

HYDRAULIC COUPLINGS

SWIVEL MANIFOLD RETAINING RING



Note that the torque tool drive components must be lubricated using the specified product only. Using alternative lubricants will affect the torque tool output and possibly lead to premature component failures.

3. It is preferable to lightly spray the torque wrench with water repellent spray (WD40), prior to placing back into storage.

### Hoses and Ancillaries

1. Clean and inspect each hydraulic hose and quick connect coupling. Check the entire length of the hose for cuts, abrasions and damage. Any evidence of hose damage and the entire hose must be replaced.
2. Coat each quick connect coupling with a water repellent spray (WD40).

# Operating Instructions

Form No. -----

Fault	Possible Cause	Remedy
Cylinder will not advance. Cylinder will not retract.	1. Coupling not fully mated 2. Cylinder seal leakage 3. Pump unit 4. Faulty coupling	1. Check coupling 2. Replace seal 3. Check pump unit 4. Replace coupling
Torque wrench operates backwards	1. Reversed couplings.	1. Check pump, hose and torque wrench for cross connection
Pressure will not build	1. Cylinder Seal leakage 2. Swivel Seal leakage 3. Defective pump unit	1. Change seals 2. Change seals 3. Check pump unitPa
Pressure builds, but wrench does not move	1. Hose restriction 2. Coupling not fully assembled	1. Change hose 2. Fully tighten coupling
Slow torque wrench operation	1. Hose restriction 2. Coupling not fully assembled 3. Pump flow rate too small	1. Change hose 2. Fully tighten coupling 3. Use higher flow pump
Erratic or slow retraction speed	1. Hose restriction 2. Coupling not fully assembled	1. Change hose 2. Fully tighten coupling
Torque wrench does not ratchet	1. Broken drive shoe 2. Jammed drive shoe 3. Damaged ratchet	1. Replace drive shoe 2. Check drive shoe and spring 3. Check / replace ratchet
Ratchet jumps whilst driving	1. Worn / damaged ratchet 2. Worn / damaged drive shoe 3. Wrench incorrectly retracted 4. Weak / snapped drive shoe spring.	1. Replace ratchet and drive shoe 2. Replace ratchet and drive shoe 3. Allow time to fully retract. 4. Replace springs
Difficulty in hose connection	1. Pressure within hose 2. Damaged coupling	1. Vent hose 2. Replace coupling

**LDF Parts List  
Here.**

# TWLC SERIES HYDRAULIC TORQUE WRENCH

## PRESSURE - TORQUE CONVERSION CHART

PUMP PRESSURE	
PSI	Bar
1200	83
1400	97
1600	110
1800	124
2000	138
2200	152
2400	165
2600	179
2800	193
3000	207
3200	221
3400	234
3600	248
3800	262
4000	276
4200	290
4400	303
4600	317
4800	331
5000	345
5200	359
5400	372
5600	386
5800	400
6000	414
6200	427
6400	441
6600	455
6800	469
7000	483
7200	496
7400	510
7600	524
7800	538
8000	552
8200	565
8400	579
8600	593
8800	607
9000	621
9200	634
9400	648
9600	662
9800	676
10000	690

		TORQUE OUTPUT lbf.ft / Nm									
		TWLC2		TWLC4		TWLC6		TWLC15		TWLC30	
		189	206	477	646	954	1293	1762	2415	3456	4583
		221	299	557	754	1113	1508	2079	2817	4032	5463
		252	341	636	862	1272	1724	2376	3220	4608	6244
		284	384	718	970	1431	1939	2673	3622	5184	7024
		315	427	795	1077	1590	2154	2970	4024	5760	7805
		347	470	875	1185	1749	2370	3267	4427	6336	8585
		378	512	954	1293	1908	2665	3564	4829	6912	9366
		410	555	1034	1400	2067	2801	3861	5232	7488	10146
		441	598	1113	1508	2226	3016	4158	5634	8064	10927
		473	640	1193	1616	2365	3232	4455	6037	8640	11707
		504	693	1272	1724	2544	3447	4752	6439	9216	12489
		536	726	1352	1831	2703	3663	5049	6841	9792	13269
		567	769	1431	1939	2862	3978	5346	7244	10368	14049
		599	811	1511	2047	3021	4093	5643	7646	10944	14829
		630	854	1590	2154	3160	4309	5940	8049	11520	15610
		662	896	1670	2262	3339	4524	6237	8451	12096	16390
		693	939	1749	2370	3498	4740	6534	8854	12672	17171
		725	992	1829	2478	3657	4955	6831	9256	13248	17951
		756	1024	1908	2685	3816	5171	7128	9659	13824	18732
		788	1067	1988	2693	3975	5386	7425	10061	14400	19512
		819	1110	2067	2901	4134	5602	7722	10463	14976	20293
		851	1152	2147	2909	4293	5917	8019	10806	15552	21073
		882	1190	2228	3016	4452	6033	8316	11268	16128	21854
		914	1238	2308	3124	4611	6248	8613	11671	16704	22634
		945	1280	2385	3232	4770	6463	8910	12073	17280	23416
		977	1323	2465	3339	4929	6679	9207	12476	17656	24195
		1008	1366	2544	3447	5088	6894	9504	12878	18432	24976
		1040	1409	2624	3555	5247	7110	9801	13250	19008	25756
		1071	1451	2703	3663	5406	7325	10098	13683	19584	26537
		1103	1494	2783	3770	5565	7541	10395	14055	20160	27317
		1134	1537	2862	3878	5724	7756	10692	14488	20736	28098
		1166	1579	2942	3986	5883	7972	10989	14890	21312	28878
		1197	1622	3021	4093	6042	8187	11286	15293	21888	29859
		1229	1665	3101	4201	6201	8402	11583	15695	22484	30439
		1260	1707	3180	4309	6360	8618	11880	16098	23040	31220
		1292	1750	3260	4417	6519	8933	12177	16500	23616	32000
		1323	1793	3339	4524	6678	9049	12474	16902	24192	32780
		1355	1835	3419	4632	6837	9264	12771	17305	24768	33561
		1386	1878	3498	4740	6996	9480	13068	17707	25344	34341
		1418	1921	3578	4848	7155	9695	13365	18110	25920	35122
		1449	1963	3657	4955	7314	9911	13662	18512	26496	35902
		1481	2006	3737	5063	7473	10126	13959	18915	27072	36683
		1512	2049	3816	5171	7632	10347	14256	19317	27648	37463
		1544	2091	3896	5279	7791	10557	14553	19720	28224	38244
		1575	2134	3975	5396	7950	10772	14850	20122	28800	39024







